



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 719 906 A1

Rz

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
08.11.2096 Bulletin 2006/45

(51) Int Cl.:

(21) Application number: 05719530.7

(86) International application number:
PCT/JP2005/003129

(22) Date of filing: 25.02.2005

(87) International publication number:
WO 2005/083261 (09.09.2005 Gazette 2005/36)

(84) Designated Contracting States:
DE FR GB IT

(72) Inventor: Akabane, A.,
Kakuda Dev. Center of Keihin Corp.
Miyagi 9811505 (JP)

(30) Priority: ~~27.02.2004 JP~~ 2004053693

(74) Representative: Prechtel, Jörg et al
Weickmann & Weickmann
Patentanwälte
Postfach 86 08 20
81635 München (DE)

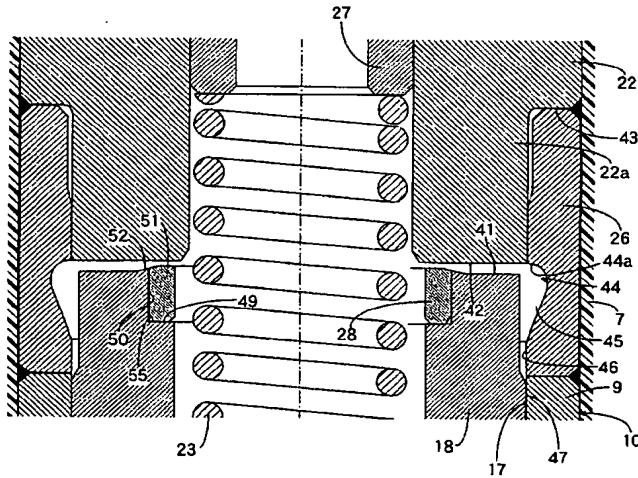
(71) Applicant: **Keihin Corporation**
Tokyo 163-0539 (JP)

(54) ELECTROMAGNETIC FUEL INJECTION VALVE AND METHOD OF MANUFACTURING THE SAME

(57) In an electromagnetic fuel injection valve in which a non-magnetic cylinder is coaxially coupled at its front end to a rear end of a magnetic cylinder forming a portion of a valve housing to surround a portion of a movable core having a rear end face serving as a movable attraction face, and a stationary core having a front end face serving as a stationary attraction face is fitted and fixed at its front portion in a rear portion of the non-magnetic cylinder, so that the stationary attraction face is opposed to the movable attraction face, the stationary core (22) is fitted and fixed at its front portion in the non-magnetic cylinder (26), so that it is in close contact with an

inner surface of an intermediate portion of the non-magnetic cylinder (26) in a region corresponding to the stationary attraction face (42), and an annular recess (44) having a flat portion (44a) flush connected to the stationary attraction face (42) is provided in an inner surface of the non-magnetic cylinder (26) to form an annular chamber (45) between the annular recess (44) and an outer periphery of a rear portion of the movable core (18). This makes it possible that the area of opposed faces of the stationary core and the movable core is set at a large value to the utmost, thereby preventing the accumulation and deposition of chips and a magnetic powder.

FIG.2



Description**TECHNICAL FIELD**

[0001] The present invention relates to an electromagnetic fuel injection valve, in which a valve member is contained in a valve housing comprising a magnetic cylinder coaxially coupled at a front end thereof to a valve seat member having a valve seat, the valve member being spring-biased in a direction in which the valve member is seated on the valve seat; a non-magnetic cylinder is coaxially coupled at a front end thereof to a rear end of the magnetic cylinder to surround a portion of a movable core which is coaxially connected to the valve member with a rear end face thereof serving as a movable attraction face; and a front portion of a stationary core having a front end face serving as a stationary attraction face is fitted into and fixed in a rear portion of the non-magnetic cylinder, so that the stationary attraction face is opposed to the movable attraction face, and a process for producing such an electromagnetic fuel injection valve.

BACKGROUND ART

[0002] There is an electromagnetic fuel injection valve already known from, for example, Patent Document 1, wherein a non-magnetic cylinder is coaxially coupled to a rear end of a magnetic cylinder forming a portion of a valve housing, and a front portion of a stationary core is fitted into and fixed in a rear portion of the non-magnetic cylinder.

Patent Document 1:

Japanese Patent Application Laid-open No.
11-166461

DISCLOSURE OF THE INVENTION**PROBLEMS TO BE SOLVED BY THE INVENTION**

[0003] In the above conventional electromagnetic fuel injection valve, a tapered chamfer is provided around an outer periphery of the front end of the stationary core in order to improve the operability for fitting the front portion of the stationary core into the rear end of the non-magnetic cylinder, and such chamfer is left as it is, after completion of the assembling. However, it is desired to set the area of opposed faces of the stationary core and the movable core at a large value to the utmost in order to reduce the size of the fuel injection valve, but if there is the chamfer formed around outer periphery of the front end of the stationary core, as described above, such area may be reduced, whereby a sufficient attraction force is not obtained in some cases. Moreover, an annular groove is formed by the chamfer between the non-magnetic cylinder and the stationary core and thus, there is a possibility that chips and a magnetic powder may enter the annular groove to become deposited therein, and

even if a removal cleaning is conducted, the chips or magnetic powder are not removed completely to exert an adverse influence to the operation of the fuel injection valve.

[0004] The present invention has been accomplished with such circumstances in view, and it is a first object of the present invention to provide an electromagnetic fuel injection valve, wherein the area of the opposed faces of the stationary core and the movable core can be set at a large value to the utmost and moreover, it is possible to prevent the accumulation and deposition of the chips and the magnetic powder. It is a second object of the present invention to provide a producing process suitable for producing such an electromagnetic fuel injection valve.

MEANS FOR SOLUTION OF PROBLEMS

[0005] To achieve the above first object, according to a first aspect of the present invention, there is provided an electromagnetic fuel injection valve, in which a valve member is contained in a valve housing comprising a magnetic cylinder coaxially coupled at a front end thereof to a valve seat member having a valve seat, the valve member being spring-biased in a direction in which the valve member is seated on the valve seat; a non-magnetic cylinder is coaxially coupled at a front end thereof to a rear end of said magnetic cylinder to surround a portion of a movable core which is coaxially connected to the valve member with a rear end face thereof serving as a movable attraction face; and a front portion of a stationary core having a front end face serving as a stationary attraction face is fitted into and fixed in a rear portion of the non-magnetic cylinder, so that the stationary attraction face is opposed to the movable attraction face, characterized in that the front portion of the stationary core is fitted and fixed in the non-magnetic cylinder so as to be in close contact with an inner surface of an intermediate portion of the non-magnetic cylinder in a region corresponding to the stationary attraction face, and an annular recess having a flat portion flush connected to the stationary attraction face is provided in the inner surface of the non-magnetic cylinder to form an annular chamber between the annular recess and an outer periphery of the rear portion of the movable core.

[0006] According to a second aspect of the present invention, in addition to the arrangement of the first aspect, a center bore having an inside diameter larger than an outside diameter of the stationary attraction face is provided in an inner periphery of the non-magnetic cylinder at a location in front of the annular recess; a guide bore is provided in an inner periphery of the magnetic cylinder and flush connected to the center bore; and a guide portion is integrally provided on the movable core having at a rear end face thereof the movable attraction face having an outside diameter substantially equal to that of the stationary attraction face to overhang sideways from the outer periphery of the movable attraction

face, so that the guide portion is slidably fitted in the guide bore.

[0007] To achieve the above second object, according to a third aspect of the present invention, there is provided a process for producing an electromagnetic fuel injection valve according to the first aspect, comprising a step of preparing a cylindrical magnetic cylinder blank and a non-magnetic cylinder blank for forming the magnetic cylinder and the non-magnetic cylinder, respectively, as well as a stationary core blank having a chamfer around the outer periphery at a front end thereof for forming the stationary core; a step of fixing the stationary core blank to the non-magnetic cylinder blank in a state in which a front portion of the stationary core blank has been fitted so as to be in close contact with an inner surface of an intermediate portion of the non-magnetic cylinder blank coaxially coupled to the magnetic cylinder blank; and a step of grinding the front portion of the stationary core blank so as to remove the chamfer, thereby forming a flat stationary attraction face, and subjecting inner peripheries of the non-magnetic cylinder blank and the magnetic cylinder blank to a grinding to form the annular recess, the center bore and the guide bore, the above steps being carried out sequentially.

EFFECT OF THE INVENTION

[0008] With the first feature of the present invention, the outer periphery of the stationary attraction face at the front end of the stationary core is flush connected to the flat portion of the annular recess provided in the inner periphery of the non-magnetic cylinder. Therefore, as compared with a stationary core having a chamfer provided around its outer periphery at its front end, it is possible to set the area of the stationary attraction face at a large value to the utmost to provide an increase in attraction force. In addition, an annular groove cannot be formed between the stationary core and the non-magnetic cylinder, and the annular chamber is defined between the movable core and the non-magnetic cylinder to surround the outer periphery of the rear portion of the movable core. Therefore, even if chips and a magnetic powder are produced, they can be fluidized and thus, can be prevented from being accumulated and deposited.

[0009] With the second feature of the present invention, an attraction force can be further increased by setting the outside diameter of the movable attraction face at a value substantially equal to that of the stationary attraction face. Moreover, the movable core is guided in the guide bore in the magnetic cylinder and hence, it is possible to provide an enhancement in attraction responsiveness.

[0010] With the third feature of the present invention, when the front portion of the stationary core blank is fitted into and fixed in the non-magnetic cylinder blank, an operation of fitting and fixing the stationary core blank in the non-magnetic cylinder blank is easy, because the

stationary core blank has the chamfer around its outer periphery at its front end. Moreover, the stationary attraction face, the annular recess, the center bore and the guide bore are formed by the grinding of the stationary core blank, the non-magnetic cylinder blank and the magnetic cylinder blank, and hence, a dust such as chips produced by the fitting and the chamfer can be removed by the grinding.

5 10 BRIEF DESCRIPTION OF DRAWINGS

[0011]

15 [Fig.1] is a vertical sectional view of an electromagnetic fuel injection valve. (Embodiment 1)
 [Fig.2] is an enlarged view of an area shown by an arrow 2 in Fig.1. (Embodiment 1)
 [Fig.3] is a sectional view for explaining the grinding of a stationary core blank, a non-magnetic cylinder blank and a magnetic cylinder blank. (Embodiment 1)
 20 [Fig.4] is a sectional view for explaining the grinding of a movable core blank and a stopper blank. (Embodiment 1)

25 30 DESCRIPTION OF REFERENCE NUMERALS AND CHARACTERS

[0012]

35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 2230 2235 2240 2245 2250 2255 2260 2265 2270 2275 2280 2285 2290 2295 2300 2305 2310 2315 2320 2325 2330 2335 2340 2345 2350 2355 2360 2365 2370 2375 2380 2385 2390 2395 2400 2405 2410 2415 2420 2425 2430 2435 2440 2445 2450 2455 2460 2465 2470 2475 2480 2485 2490 2495 2500 2505 2510 2515 2520 2525 2530 2535 2540 2545 2550 2555 2560 2565 2570 2575 2580 2585 2590 2595 2600 2605 2610 2615 2620 2625 2630 2635 2640 2645 2650 2655 2660 2665 2670 2675 2680 2685 2690 2695 2700 2705 2710 2715 2720 2725 2730 2735 2740 2745 2750 2755 2760 2765 2770 2775 2780 2785 2790 2795 2800 2805 2810 2815 2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870 2875 2880 2885 2890 2895 2900 2905 2910 2915 2920 2925 2930 2935 2940 2945 2950 2955 2960 2965 2970 2975 2980 2985 2990 2995 3000 3005 3010 3015 3020 3025 3030 3035 3040 3045 3050 3055 3060 3065 3070 3075 3080 3085 3090 3095 3100 3105 3110 3115 3120 3125 3130 3135 3140 3145 3150 3155 3160 3165 3170 3175 3180 3185 3190 3195 3200 3205 3210 3215 3220 3225 3230 3235 3240 3245 3250 3255 3260 3265 3270 3275 3280 3285 3290 3295 3300 3305 3310 3315 3320 3325 3330 3335 3340 3345 3350 3355 3360 3365 3370 3375 3380 3385 3390 3395 3400 3405 3410 3415 3420 3425 3430 3435 3440 3445 3450 3455 3460 3465 3470 3475 3480 3485 3490 3495 3500 3505 3510 3515 3520 3525 3530 3535 3540 3545 3550 3555 3560 3565 3570 3575 3580 3585 3590 3595 3600 3605 3610 3615 3620 3625 3630 3635 3640 3645 3650 3655 3660 3665 3670 3675 3680 3685 3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740 3745 3750 3755 3760 3765 3770 3775 3780 3785 3790 3795 3800 3805 3810 3815 3820 3825 3830 3835 3840 3845 3850 3855 3860 3865 3870 3875 3880 3885 3890 3895 3900 3905 3910 3915 3920 3925 3930 3935 3940 3945 3950 3955 3960 3965 3970 3975 3980 3985 3990 3995 4000 4005 4010 4015 4020 4025 4030 4035 4040 4045 4050 4055 4060 4065 4070 4075 4080 4085 4090 4095 4100 4105 4110 4115 4120 4125 4130 4135 4140 4145 4150 4155 4160 4165 4170 4175 4180 4185 4190 4195 4200 4205 4210 4215 4220 4225 4230 4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235 5240 5245 5250 5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 6230 6235 6240 6245 6250 6255 6260 6265 6270 6275 6280 6285 6290 6295 6300 6305 6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360 6365 6370 6375 6380 6385 6390 6395 6400 6405 6410 6415 6420 6425 6430 6435 6440 6445 6450 6455 6460 6465 6470 6475 6480 6485 6490 6495 6500 6505 6510 6515 6520 6525 6530 6535 6540 6545 6550 6555 6560 6565 6570 6575 6580 6585 6590 6595 6600 6605 6610 6615 6620 6625 6630 6635 6640 6645 6650 6655 6660 6665 6670 6675 6680 6685 6690 6695 6700 6705 6710 6715 6720 6725 6730 6735 6740 6745 6750 6755 6760 6765 6770 6775 6780 6785 6790 6795 6800 6805 6810 6815 6820 6825 6830 6835 6840 6845 6850 6855 6860 6865 6870 6875 6880 6885 6890 6895 6900 6905 6910 6915 6920 6925 6930 6935 6940 6945 6950 6955 6960 6965 6970 6975 6980 6985 6990 6995 7000 7005 7010 7015 7020 7025 7030 7035 7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090 7095 7100 7105 7110 7115 7120 7125 7130 7135 7140 7145 7150 7155 7160 7165 7170 7175 7180 7185 7190 7195 7200 7205 7210 7215 7220 7225 7230 7235 7240 7245 7250 7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 9625 9630 9635 9640 9645 9650 9655 9660 9665 9670 9675 9680 9685 9690 9695 9700 9705 9710 9715 9720 9725 9730 9735 9740 9745 9750 9755 9760 9765 9770 9775 9780 9785 9790 9795 9800 9805 9810 9815 9820 9825 9830 9835 9840 9845 9850 9855 9860 9865 9870 9875 9880 9885 9890 9895 9900 9905 9910 9915 9920 9925 9930 9935 9940 9945 9950 9955 9960 9965 9970 9975 9980 9985 9990 9995 10000 10005 10010 10015 10020 10025 10030 10035 10040 10045 10050 10055 10060 10065 10070 10075 10080 10085 10090 10095 10100 10105 10110 10115 10120 10125 10130 10135 10140 10145 10150 10155 10160 10165 10170 10175 10180 10185 10190 10195

44 *** Annular recess

44a *** Flat portion

45 *** Annular chamber

46 *** Center bore

47 *** Guide portion

48 *** Chamfer

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] The mode for carrying out the present invention will now be described by way of one embodiment of the present invention shown in the accompanying drawings.

EMBODIMENT 1

[0014] Figs. 1 to 4 show one embodiment of the present invention.

[0015] Referring first to Fig. 1, an electromagnetic fuel injection valve for injecting fuel into an engine which is not shown includes a valve section 5 which comprises a valve housing 8 having a valve seat 13 at its front end, and a valve member 20 contained in the valve housing and spring-biased in a direction to be seated on the valve seat 13, a solenoid section 6 in which a coil assembly 24 capable of exhibiting an electromagnetic force for driving the valve member 20 in a direction to be unseated from the valve seat 13 is contained in a solenoid housing 25 connected to the valve housing 8, and a covering section 7 made of a synthetic resin which is integrally provided with a coupler 40 faced by connection terminals 38 connected to a coil 30 of the coil assembly 24 and in which at least the coil assembly 24 and the solenoid housing 25 are embedded.

[0016] The valve housing 8 is comprised of a magnetic cylinder 9 formed of a magnetic metal, and a valve seat member 10 liquid-tightly coupled to a front end of the magnetic cylinder 9. The valve seat member 10 is welded to the magnetic cylinder 9 in a state in which its rear end has been fitted into a front end of the magnetic cylinder 9. The valve seat member 10 includes a fuel outlet bore 12 opening into a front end face of the valve seat member 10, a tapered valve seat 13 connected to an inner end of the fuel outlet bore 12, and a guide bore 14 connected to a larger-diameter portion at a rear end of the valve seat 13, all of which are coaxially provided in the valve seat member 10. An injector plate 16 made of a steel plate having a plurality of fuel injection bores 15 leading to the fuel outlet bore 12 is liquid-tightly welded over the entire periphery to a front end of the valve seat member 10.

[0017] A movable core 18 forming a portion of the solenoid section 6 is slidably received in a rear portion of the valve housing 8, and the valve member 20 capable

of being seated on the valve seat 13 to close the fuel outlet bore 12 is integrally formed at a front end of a valve stem 19 integrally connected to the movable core 18, so that it is guided in the guide bore 14. A through-hole 21 is coaxially formed in a bottomed configuration with its front end closed in the movable core 18, the valve stem 19 and the valve member 20 to lead to the inside of the valve housing 8.

[0018] The solenoid section 6 includes the movable core 18, a cylindrical stationary core 22 opposed to the movable core 18, a return spring 23 for exhibiting a spring force for biasing the movable core 18 away from the stationary core 22, the coil assembly 24 disposed to surround the rear portion of the valve housing 8 and the stationary core 22, while enabling the exhibition of an electromagnetic force for attracting the movable core 18 toward the stationary core 22 again the spring force of the return spring 23, and the solenoid housing 25 provided to surround the coil assembly 24 in such a manner that a front end of the solenoid housing 25 is connected to the valve housing 8.

[0019] The magnetic cylinder 9 of the valve housing 8 is coaxially coupled at its rear end to a front end of the stationary core 22 through a non-magnetic cylinder 26 formed of a material which is non-magnetic or magnetic weakly more than the stationary core 22, for example, a non-magnetic metal such as a stainless steel in the present embodiment. The rear end of the magnetic cylinder 9 is butt-welded to the front end of the non-magnetic cylinder 26, and the rear end of the non-magnetic cylinder 26 is welded to the stationary core 22 in a state in which the front end of the stationary core 22 has been fitted into the non-magnetic cylinder 26.

[0020] A cylindrical retainer 27 is coaxially fitted into and fixed to the stationary core 22 by caulking, and the return spring 23 is interposed between the retainer 27 and the movable core 18. A ring-shaped stopper 28 made of a non-magnetic material is press-fitted into an inner periphery of a rear end of the movable core 18 in such a manner that it protrudes slightly from a rear end face of the movable core 18 toward the stationary core 22 in order to avoid the direct contact of the movable core 18 with the stationary core 22. The coil assembly 24 comprises the coil 30 wound around a bobbin 29 which surrounds the rear portion of the valve housing 8, the non-magnetic cylinder 26 and the stationary core 22.

[0021] The solenoid housing 25 comprises a magnetic frame 31 which is formed of a magnetic metal in a cylindrical shape surrounding the coil assembly 24 and has at one end an annular end wall 31a opposed to an end of the coil assembly 24 closer to the valve section 5, and a flange 22a overhanging radially outwards from the rear end of the stationary core 22 and opposed to an end of the coil assembly 24 opposite from the valve section 5. The flange 22a is magnetically coupled to the other end of the magnetic frame 31. Moreover, a fitting cylindrical portion 31b is coaxially provided on an inner periphery of the end wall 31a of the magnetic frame 31, and the

magnetic cylinder 9 of the valve housing 8 is fitted into the fitting cylindrical portion 31b. The solenoid housing 25 is connected to the valve housing 8 by fitting the valve housing 8 into the fitting cylindrical portion 31b.

[0022] A cylindrical inlet tube 33 is integrally and coaxially connected to the rear end of the stationary core 22, and a fuel filter 34 is mounted in a rear portion of the inlet tube 33. Moreover, a fuel passage 35 is coaxially provided in the inlet tube 33, the retainer 23 and the stationary core 22 to lead to the through-hole 21 in the movable core 18.

[0023] The covering section 7 is formed so that not only the solenoid housing 25 and the coil assembly 24 but also a portion of the valve housing 8 and most of the inlet tube 33 are embedded in the covering section 7, while ensuring that a gap between the solenoid housing 25 and the coil assembly 24 is filled. The magnetic frame 31 of the solenoid housing 25 is provided with a notch 36 for disposing an arm portion 29a integrally formed on the bobbin 29 of the coil assembly 24 outside the solenoid housing 25.

[0024] The covering section 7 is integrally provided with the coupler 40 faced by the connection terminals 38 connected to opposite ends of the coil 30 of the coil assembly 24. Base ends of the connection terminals 38 are embedded in the arm portion 29a, and coil ends 30a of the coil 30 are welded to the connection terminals 38.

[0025] Referring to Fig.2, the non-magnetic cylinder 26 is coaxially coupled at its front end by butt-welding to the rear end of the magnetic cylinder 9 of the valve housing 8 so as to surround a portion of the movable core 18 having the rear end face serving as a movable attraction face 41. A front portion of the stationary core 22 having a front end face serving as a stationary attraction face 42 is fitted into and fixed in a rear portion of the non-magnetic cylinder 26 in such a manner that the stationary attraction face 42 is opposite to the movable attraction face 41.

[0026] A smaller-diameter fitting portion 22a is coaxially provided in the front area of the stationary core 22 to form an annular step 43 facing forwards around its outer periphery, so that the stationary attraction face 42 is formed at a front end of the smaller-diameter fitting portion 22a. The smaller-diameter fitting portion 22a is fitted into the rear portion of the non-magnetic cylinder 26 until the step 43 abuts against the rear end of the non-magnetic cylinder 26, so that the smaller-diameter fitting portion 22a is in close contact with an inner surface of an intermediate portion of the non-magnetic cylinder 26 in a region corresponding to the stationary attraction face 42. In this state, the stationary core 22 is fixed to the non-magnetic cylinder 26 by welding.

[0027] Moreover, an annular recess 44 having a flat portion 44a flush connected to an outer periphery of the stationary attraction face 42 of the stationary core 22 is provided in the inner surface of the non-magnetic cylinder 26 to form an annular chamber 45 between the annular recess 44 and an outer periphery of the rear portion of

the movable core 18.

[0028] A center bore 46 having an inside diameter larger than an outside diameter of the stationary attraction face 42 is formed in an inner periphery of the non-magnetic cylinder 26 at a location in front of the annular recess 44, and a guide bore 17 having a diameter larger than that of the guide bore 14 in the valve seat member 10 is provided in an inner periphery of the magnetic cylinder 9, so that it is flush connected to the center bore 46.

[0029] On the other hand, the movable attraction face 41 having a diameter substantially equal to that of the stationary attraction face 42 is formed on the rear end face of the movable core 18, but a guide portion 47 is integrally provided on the movable core 18 to overhang sideways from the outer periphery of the movable attraction face 41, so that it is slidably fitted in the guide bore 17.

[0030] Referring to Fig.3, to couple the stationary core 22 to the rear portion of the valve housing 8 through the non-magnetic cylinder 26, at first, a cylindrical magnetic cylinder blank 9' a ring-shaped non-magnetic cylinder blank 26' and a stationary core blank 22' having shapes shown by dashed lines in Fig.3, are prepared in order to form the magnetic cylinder 9, the non-magnetic cylinder 26 and the stationary core 22.

[0031] The non-magnetic cylinder blank 26' is formed into a cylindrical shape having an inner periphery increased in diameter at three stages in a rearward direction, and the magnetic cylinder blank 9' is formed into a cylindrical shape having an inside diameter corresponding to an inside diameter of a front end of the non-magnetic cylinder blank 26'. Further, the stationary core blank 22' is formed to previously have a front portion of a smaller-diameter tube portion 22a' corresponding to the smaller-diameter fitting portion 22a of the stationary core 22, and an annular step 43 surrounding a base end of the smaller-diameter tube portion 22a'. The length of protrusion of the smaller-diameter tube portion 22a' from the step 43 is set at a value larger than the length of protrusion of the smaller-diameter fitting portion 22a from the step 43. Moreover, a tapered chamfer 48 is provided around an outer periphery of a front end of the smaller-diameter tube portion 22a'.

[0032] Then, the smaller-diameter tube portion 22a' is fitted into the non-magnetic cylinder blank 26', so that the outer periphery of the front area of the smaller-diameter tube portion 22a' is in close contact with the inner surface of the intermediate portion of the non-magnetic cylinder blank 26' already coaxially coupled to the magnetic cylinder blank 9', and in a state in which the rear end of the non-magnetic cylinder blank 26' is in abutment against the step 43, the stationary core blank 22' is fixed to the non-magnetic cylinder blank 26' by welding.

[0033] In this case, the operation of fitting the front portion of the stationary core blank 22', i.e., the smaller-diameter tube portion 22a' into the non-magnetic cylinder blank 26' is easy, because the chamfer 48 is provided around the outer periphery of the front end of the smaller-diameter tube portion 22a' at the front portion of the sta-

tionary core blank 22', and the non-magnetic cylinder blank 26' is formed into the cylindrical shape having the inner periphery increased in diameter at the three stages in the rearward direction.

[0034] After the coupling of the stationary core blank 22', the non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' as described above, the front portion of the smaller-diameter tube portion 22a' of the stationary core blank 22' is ground to remove the chamfer 48, whereby a flat stationary attraction face 42 is formed, and the inner peripheries of the non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' are subjected to a grinding treatment, whereby an annular recess 44, a center bore 46 and a guide bore 14 are formed.

[0035] Referring again to Fig. 2, the recess 50 having the annular step 49 facing rearwards at its inner end is provided in the inner periphery of the rear portion of the movable core 18, and the ring-shaped stopper 28 is press-fitted into the recess 50 in such a manner that its front end abuts against the step 49. A flat abutment face 51 is disposed at a location displaced from the flat movable attraction face 41 formed at the rear end of the movable core 18 toward the stationary attraction face 42, and is formed to be able to abut against the stationary attraction face 42 at the rear end of the stopper 28. A slant 52 is formed in a tapered shape or an arcuate shape on the inner periphery of the rear end of the movable core 18 and the outer periphery of the rear end of the stopper 28 to connect continuously and smoothly the movable attraction face 41 and the abutment face 51 to each other.

[0036] Referring to Fig. 4, to couple the stopper 28 to the movable core 18, at first, a cylindrical movable core blank 18' and a ring-shaped stopper blank 28' having shapes shown by dashed lines in Fig. 4 are prepared in order to form the movable core 18 and the stopper 28, respectively.

[0037] The movable core blank 18' is formed into a cylindrical shape extending longer rearwards than the movable core 18 to be formed. Provided in an inner periphery of a rear portion of the movable core blank 18' are a smaller-diameter bore 50' corresponding to the recess 50 in the movable core 18 to form an annular step 49 at an inner end, and a larger-diameter bore 53 which is formed at a diameter larger than that of the smaller-diameter bore 50' and which is coaxially connected to a rear end of the smaller-diameter bore 50' and opens into a rear end of the movable core blank 18', so that the smaller-diameter bore 50' is longer than the recess 50. A tapered step 54 is formed between the smaller-diameter bore 50' and the larger-diameter bore 53. On the other hand, the stopper blank 28' is also axially longer than the stopper 28 to be formed, and a tapered chamfer 55 is provided around an outer periphery of a front end of the stopper blank 28'.

[0038] Then, the front end of the stopper blank 28' is press-fitted into the smaller-diameter bore 50' in the rear portion of the movable core blank 18', until the front end of the stopper blank 28' abuts against the step 49. In this

case, an operation of press-fitting the stopper blank 28' into the smaller-diameter bore 50' in the rear portion of the movable core blank 18' is easy, because the rear end of the smaller-diameter bore 50' is connected to the larger-diameter bore 53 opening into the rear end of the movable core blank 18' through the tapered step 49, and the chamfer 55 is provided around the outer periphery of the front end of the stopper blank 28'.

[0039] After press-fitting of the stopper blank 28' into the rear portion of the movable core blank 18', the rear ends of the stopper blank 28' and the movable core blank 18' are ground, whereby a movable attraction face 41, an abutment face 51 and a slant 52 are formed. In addition, the rear portion of the stopper blank 28' and the rear portion of the movable core blank 18' are cut off, and the recess 50 is formed by a portion of the smaller-diameter bore 50'.

[0040] Next, the operation of this embodiment will be described below. The front portion of the stationary core 22 is fitted and fixed in the non-magnetic cylinder 26 in such a manner that it is in close contact with the inner surface of the intermediate portion of the non-magnetic cylinder 26 in the region corresponding to the stationary attraction face 42, and the annular recess 44 having the flat portion 44a flush connected to the stationary attraction face 42 is provided in the inner surface of the non-magnetic cylinder 26, so that the annular chamber 45 is defined between the annular recess 44 and the outer periphery of the rear portion of the movable core 18.

[0041] Therefore, as compared with a stationary core having a chamfer provided around its outer periphery at its front end, it is possible to set the area of the stationary attraction face 42 at a large value to the utmost to provide an increase in attraction force. In addition, an annular groove cannot be formed between the stationary core 22 and the non-magnetic cylinder 26, and the annular chamber 45 is defined between the movable core 18 and the non-magnetic cylinder 26 to surround the outer periphery of the rear portion of the movable core 18. Therefore, even if chips and a magnetic powder are produced, they can be fluidized and thus, can be prevented from being accumulated and deposited.

[0042] In addition, the center bore 46 having the inside diameter larger than the outside diameter of the stationary attraction face 42 is formed in the inner periphery of the non-magnetic cylinder 26 at the location in front of the annular recess 44; the guide bore 17 is provided in the inner periphery of the magnetic cylinder 9, so that it is flush connected to the center bore 46; and the movable core 18 provided at its rear end face with the movable attraction face 41 having the outside diameter substantially equal to that of the stationary attraction face 42 has the guide portion 47 integrally provided thereon to overhang sideways of the outer periphery of the movable attraction face 41, so that the guide portion 47 is slidably fitted into the guide bore 17. Therefore, the attraction force can be further increased by setting the outside diameter of the movable attraction face 41 at the value

substantially equal to the outside diameter of the stationary attraction face 42, and moreover, an enhancement in attraction responsiveness can be provided in such a manner that the movable core 18 is guided in the guide bore 17 in the magnetic cylinder 9.

[0042] To couple the stationary core 22 to the rear portion of the valve housing 8 through the non-magnetic cylinder 26, the following steps are carried out sequentially: a step of preparing the cylindrical magnetic cylinder blank 9' and the non-magnetic cylinder blank 26' for forming the magnetic cylinder 9 and the non-magnetic cylinder 26, respectively, as well as the stationary core blank 22' having the chamfer 48 around its outer periphery at its front end for forming the stationary core 22, a step of fixing the stationary core blank 22' to the non-magnetic cylinder blank 26' in a state in which the front end of the stationary core blank 22' has been fitted to come into close contact with the inner surface of the intermediate portion of the non-magnetic cylinder blank 26' coaxially coupled to the magnetic cylinder blank 9', and a step of grinding the front portion of the stationary core blank 22' so as to remove the chamfer 48, thereby forming the flat stationary attraction face 42, and subjecting the inner peripheries of the non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' to the grinding to form the annular recess 44, the center bore 46 and the guide bore 14.

[0043] Therefore, when the front portion of the stationary core blank 22' is fitted and fixed in the non-magnetic cylinder blank 26', the fitting and fixing operation is easy, because the stationary core blank 22' has the chamfer 48 around the outer periphery at its front end. Moreover, the stationary attraction face 42, the annular recess 44, the center bore 46 and the guide bore 17 are formed by the grinding of the stationary core blank 22', the non-magnetic cylinder blank 26' and the magnetic cylinder blank 9' and hence, a dust such as chips produced by the fitting and the chamfer 48 can be removed by the grinding.

[0044] In addition, the ring-shaped stopper 28 made of a material non-magnetic or weakly magnetic more than the movable core 18 is press-fitted into the inner periphery of the rear portion of the movable core 18. The flat abutment face 51 is disposed at the location displaced from the flat movable attraction face 41 formed at the rear end of the movable core 18 toward the stationary attraction face 42 of the stationary core 22, and is formed at the rear end of the stopper 28 to be able to abut against the stationary attraction face 42. The slant 52 is formed on the inner periphery of the rear end of the movable core 18 and the outer periphery of the rear end of the stopper 28 to continuously and smoothly connect the movable attraction face 42 and the abutment face 51 to each other.

[0045] Therefore, when the movable core 18 has been attracted to the stationary core 22, the stopper 28 is put into abutment against the stationary attraction face 42. Thus, a suitable air gap can be retained between the stationary and movable attraction faces 41 and 42, and

the stopper 28 is press-fitted in the inner periphery of the rear portion of the movable core 18 and hence, it is possible to decrease the number of parts and the number of assembling steps to provide a reduction in cost.

5 [0046] Moreover, by setting the area of the abutment face 51 at a small value to the utmost to reduce the area of contact of the abutment face 51 with the stationary attraction face 42, it is possible to suppress the adherence of the abutment face 51 to the stationary attraction face 42 and to suppress the wear of the abutment face 51 due to the contact to enhance the durability.

[0047] Formed on the inner periphery of the rear end of the movable core 18 and the outer periphery of the rear end of the stopper 28 is the slant 52 which continuously and smoothly connects the flat movable attraction face 41 and the flat abutment face 51 disposed at the location displaced from the movable attraction face 41 toward the stationary core 22. Therefore, an annular groove cannot be formed between the outer periphery of the stopper 28 and the inner periphery of the rear end of the movable core 18 and hence, it is possible to prevent the entrance and deposition of chips or a magnetic power, thereby preventing the generation of an adverse influence to the operation of the fuel injection valve due to the chips or the magnetic power.

20 [0048] Further, it is possible to substantially increase the area of application of an electromagnetic attraction force to the movable core 18 by a portion of the slant 52 continuously and smoothly connecting the flat movable attraction face 42 and the flat abutment face 51 to each other, thereby ensuring a sufficient attraction force and a responsiveness despite the reduction in size of the electromagnetic fuel injection valve.

25 [0049] In addition, to couple the stopper 28 to the movable core 18, the following steps are carried out sequentially: the step of preparing the cylindrical movable core blank 18' and the ring-shaped stopper blank 28' for forming the movable core 18 and the stopper 28, respectively, the step of press-fitting the front portion of the stopper blank 28' into the movable core blank 18' to fix the stopper blank 28' in to the movable core blank 18', and the step of grinding the rear portions of the stopper blank 28' and the movable core blank 18' to form the movable attraction face 41, the abutment face 51 and the slant 52. Therefore, the dust such as the chips produced by the press-fitting can be removed by the grinding.

30 [0050] Although the embodiment of the present invention has been described, it will be understood that the present invention is not limited to the above-described embodiment, and various modifications in design may be made without departing from the scope of the present invention defined in claims.

55 Claims

1. (amended) An electromagnetic fuel injection valve, in which a valve member (20) is contained in a valve

housing (8) comprising a magnetic cylinder (9) coaxially coupled at a front end thereof to a valve seat member (10) having a valve seat (13), said valve member (20) being spring-biased in a direction in which said valve member (20) is seated on said valve seat (13); a non-magnetic cylinder (26) serving as a member different from said magnetic cylinder (9) is coaxially coupled at a front end thereof to a rear end of the magnetic cylinder (9) to surround a portion of a movable core (18) which is coaxially connected to said valve member (20) with a rear end face thereof serving as a movable attraction face (41); and a front portion of a stationary core (22) having a front end face serving as a stationary attraction face (42) is fitted into and fixed in a rear portion of said non-magnetic cylinder (26), so that said stationary attraction face (42) is opposed to said movable attraction face (41), **characterized in that** the front portion of said stationary core (22) is fitted and fixed in said non-magnetic cylinder (26) so as to be in close contact with an inner surface of an intermediate portion of said non-magnetic cylinder (26) in a region corresponding to said stationary attraction face (42), and in the inner peripheral surface of said non-magnetic cylinder (26), an annular recess (44) having a flat portion (44a) flush connected to said stationary attraction face (42) is provided to form an annular chamber (45) between said annular recess (44) and an outer periphery of the rear portion of said movable core (18), and in the inner peripheral surface of said non-magnetic cylinder (26), a center bore (46) having an inside diameter larger than an outside diameter of said stationary attraction face (42) is further provided at a location in front of said annular recess (44), a guide bore (17) is provided in an inner periphery of said magnetic cylinder (9) and flush connected to said center bore (46) of the non-magnetic cylinder (26), and said annular chamber (45) is formed by continuously connecting said flat portion (44a) of said annular recess (44) and said center bore (46) and guide bore (17) by means of an inclined surface.

2. (amended) An electromagnetic fuel injection valve according to claim 1, wherein a guide portion (47) is integrally provided on said movable core (18) having at a rear end face thereof said movable attraction face (41) having an outside diameter substantially equal to that of said stationary attraction face (42) to overhang sideways from the outer periphery of said movable attraction face (41), so that said guide portion (47) is slidably fitted in said guide bore (17).
3. A process for producing an electromagnetic fuel injection valve according to claim 1, comprising a step of preparing a cylindrical magnetic cylinder blank (9') and a non-magnetic cylinder blank (26') for forming said magnetic cylinder (9) and said non-magnetic

5 cylinder (26), respectively, as well as a stationary core blank (22') having a chamfer (48) around the outer periphery at a front end thereof for forming said stationary core (22); a step of fixing said stationary core blank (22') to said non-magnetic cylinder blank (26') in a state in which a front portion of said stationary core blank (22') has been fitted so as to be in close contact with an inner surface of an intermediate portion of said non-magnetic cylinder blank (26') coaxially coupled to said magnetic cylinder blank (9'); and a step of grinding the front portion of said stationary core blank (22') so as to remove said chamfer (48), thereby forming a flat stationary attraction face (42), and subjecting inner peripheries of said non-magnetic cylinder blank (26') and said magnetic cylinder blank (9') to a grinding to form said annular recess (44), said center bore (46) and said guide bore (14), the above steps being carried out sequentially.

25

30

35

40

45

50

55

FIG.1

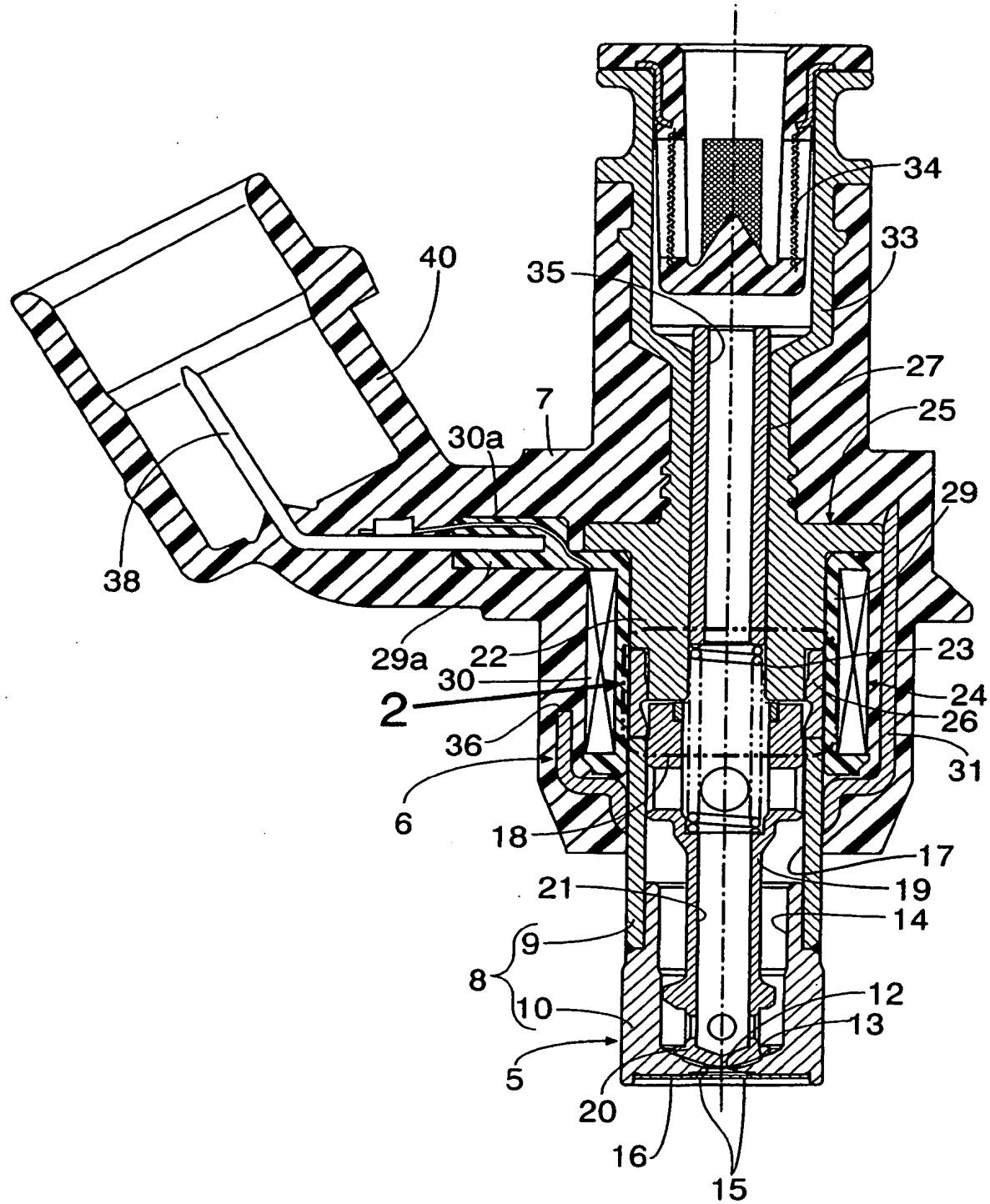


FIG.2

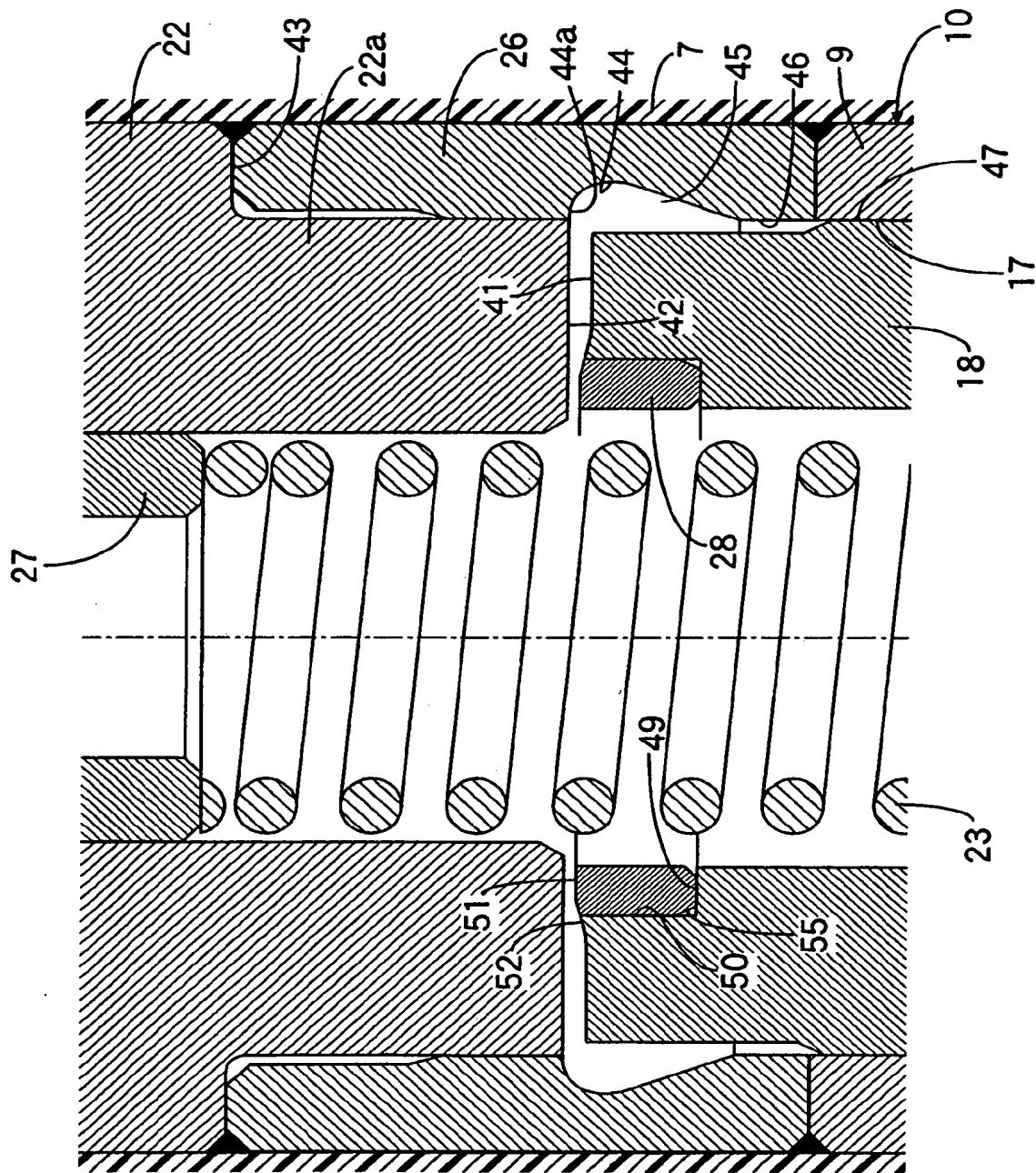


FIG. 3

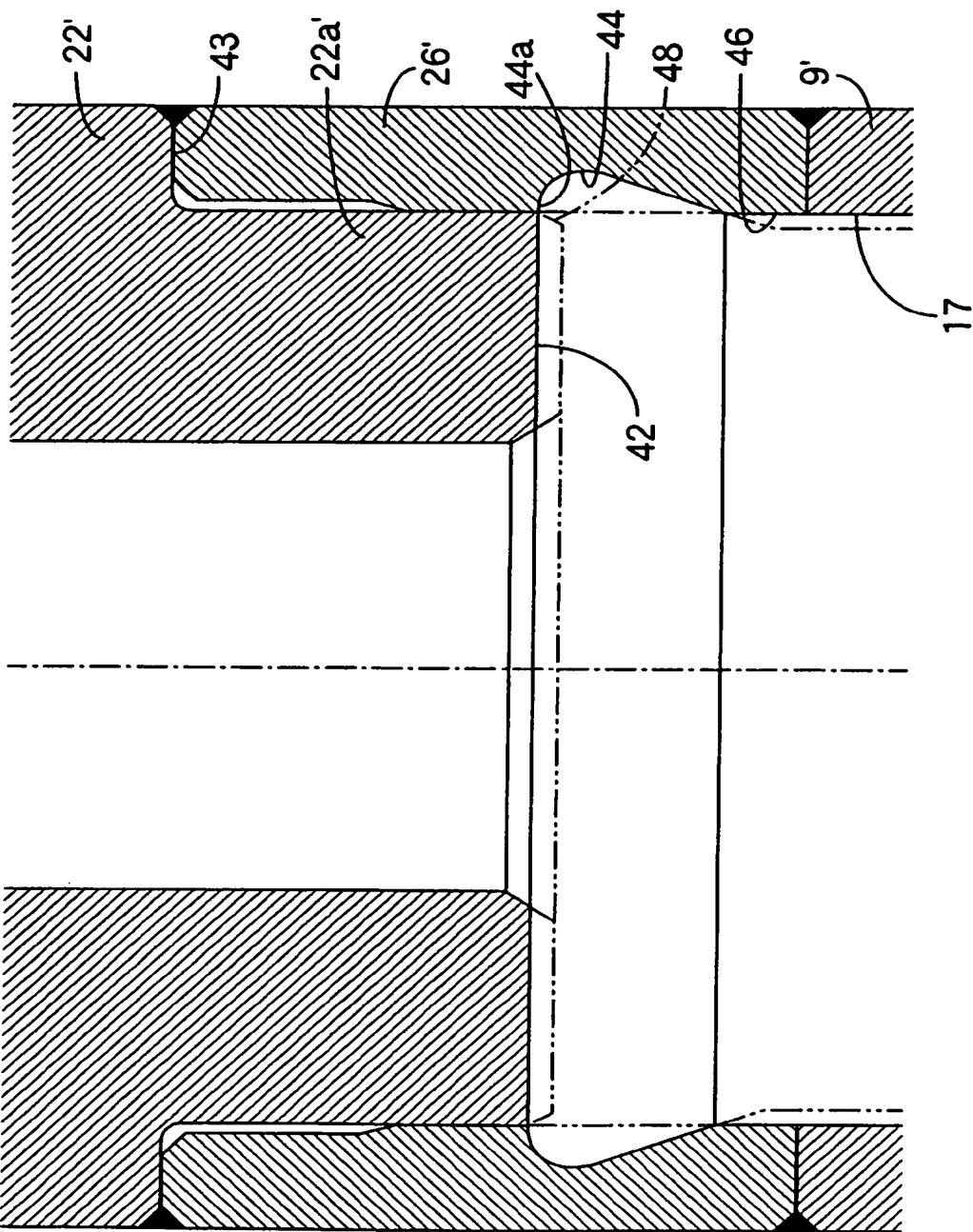
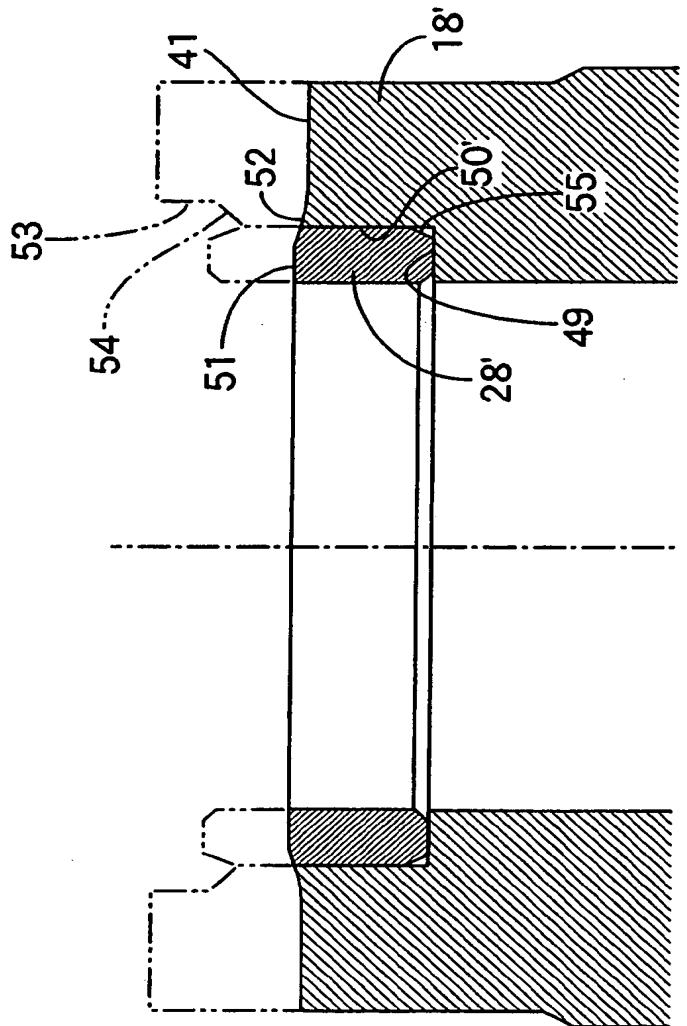


FIG.4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/003129

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl⁷ F02M51/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl⁷ F02M51/06Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005
Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 7-279794 A (Toyota Motor Corp.), 27 October, 1995 (27.10.95), Full text; Figs. 1 to 3 (Family: none)	1, 3 2
Y	JP 7-189852 A (Mitsubishi Electric Corp.), 28 July, 1995 (28.07.95), Par. Nos. [0048] to [0049]; Figs. 1 to 2 (Family: none)	2

 Further documents are listed in the continuation of Box C. See patent family annex.

Special categories of cited documents:	
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier application or patent but published on or after the international filing date
"I"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search
30 May, 2005 (30.05.05)Date of mailing of the international search report
14 June, 2005 (14.06.05)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 11166461 A [0002]